on copper surfaces with relatively small amount of deposits produced on nickel and stainless steel surfaces. Large lumps of deposits seen as black spots in the micrograph for the copper deposits in Figure 1, did not give any C-H stretching bands, indicating that the deposit in these regions consisted mainly of solid carbon. An SEM examination of these lumps showed that they consisted of short fibers which were fused together[10]. The relatively thin layers of the deposits around the spotty deposits gave, however, distinctly different FTIR spectra with a strong aromatic C-H stretching band at 3050 cm^{-1}, as shown in Figure 1. The spectra obtained from these regions also showed aliphatic C-H stretching bands at 2955, 2925, and 2865 cm^{-1} attributed to CH_3 and CH_2 groups. These observations confirm the activity of the copper surface in catalyzing the formation of fibrous deposits from aromatic PAH produced during the pyrolysis of JP-8 jet fuel as proposed and discussed in more detail elsewhere[10].

The FTIR spectrum of the deposit found on the nickel coupon showed much less intense aromatic C-H band and more broad aliphatic C-H bands, as shown in Figure 1, compared to those obtained from the deposit on copper. A SEM examination of the nickel deposit did not show any filamentous carbon[10]. As different from copper and stainless steel coupons, the two sides of the nickel coupons appeared different under the microscope. The micrograph of the nickel surface in Figure 1 shows the more smooth side of the nickel foil with visible streaks; the other side appears to be more rough and grainy. No apparent difference was observed between the different sides of the coupons after stressing with the jet fuel, however, different deposition pattems were observed on the different sides of the nickel coupons during the pyrolysis of Norpar-13, as discussed later.

The deposits on the 304 stainless steel coupon gave a featureless spectrum, as shown in Figure 1, and no filamentous carbon was observed by SEM examination. The layers of deposits shown in the micrograph in Figure consist most likely of pyrolytic carbon.

The differences observed in the FTIR spectra of deposits on the three metal substrates indicate that the nature of the metal surface strongly affects the solid deposition from thermally stressed jet fuel. Both precursors to solids and the deposition mechanisms can be different on different metal surfaces.

Figure 2 shows the FTIR spectra and the micrographs of the deposits obtained on different sides of the nickel coupon from pyrolysis of Norpar-13 at 575°C and 500 psig in the flow reactor. Side A is the relatively smooth, and side B is the rough and grainy side of the coupons. Much heavier deposition was observed on the rough side of the coupon, as shown in the micrographs. The deposits on the rough side consisted mostly of filamentous carbon which gives the featureless spectrum in Figure 2. In contrast, the smooth side did not contain much filamentous carbon, seen as black spots on the micrograph, and the spectra obtained from regions other than the black spots gave relatively strong aliphatic C-H bands, as shown in Figure 2. The high activity of the rough surface for filamentous carbon formation can be explained with the relative ease of lifting metal particles from the surface in accordance with the mechanism proposed for filamentous carbon formation[11].

Figure 3 compares the FTIR spectra obtained from the deposits on the three metal coupons from pyrolysis of n-dodecane in a batch reactor at 450°C and 1500 psig for 3 and 5 hours. After 3 hours of reaction, the deposits on copper and nickel coupons gave stronger aromatic C-H bands than that seen from the 304 stainless steel deposits. There is not much difference in the spectra of the deposits on the different metal coupons after 5 hours of reaction. In all the cases, the aromatic C-H bands became more intense with time, indicating that the formation of aromatic compounds dominate the deposition process, as proposed earlier [5]. Under these conditions, incipient fibrous deposits were observed on the copper coupons, indicating, again, the catalytic activity of copper in producing fibrous carbon from aromatic compounds. Filamentous carbon was observed on the nickel coupon after 5 hours, suggesting that the precursors to filamentous carbon on the nickel surface are different from those leading to fibrous deposits on the copper surface. No filamentous carbon was observed on the 304 stainless steel coupon under the reaction conditions used for n-dodecane pyrolysis in the batch reactor.

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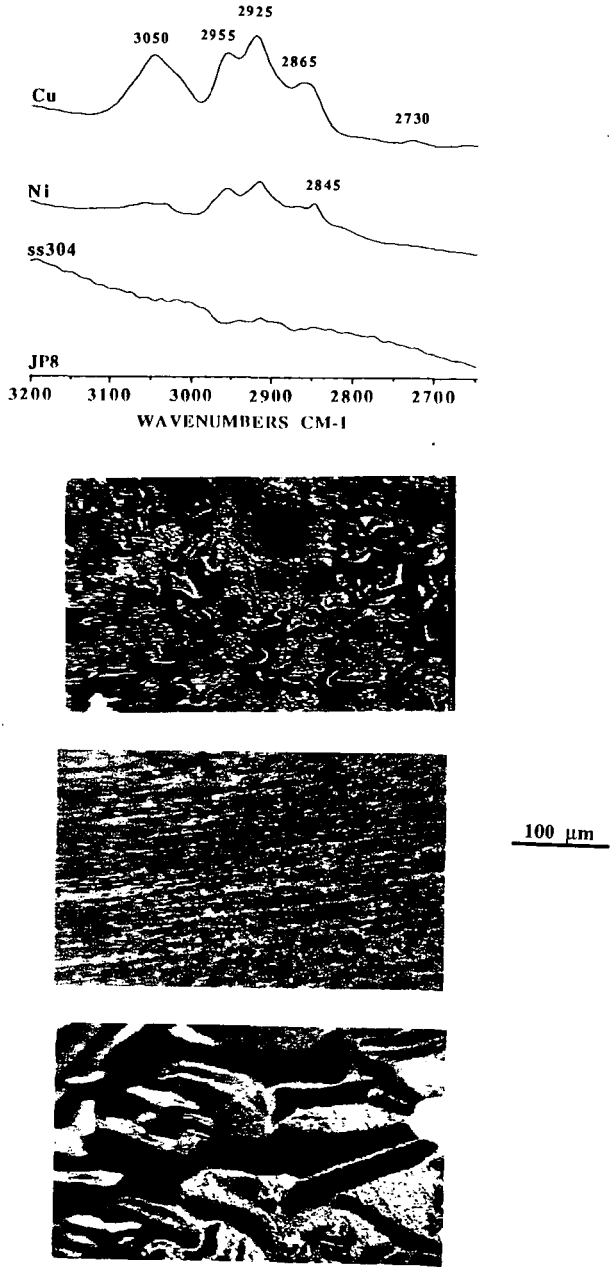
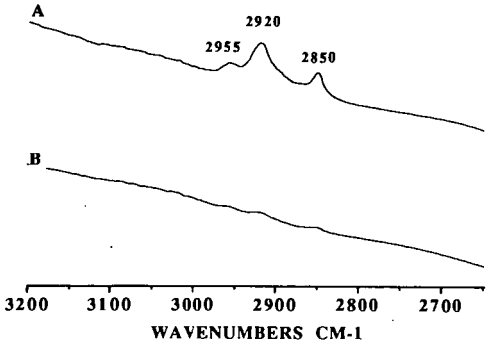


Figure 1. Micro FT-IR spectra and micrographs of solid deposits from JP-8 jet fuel on different metal substrates.



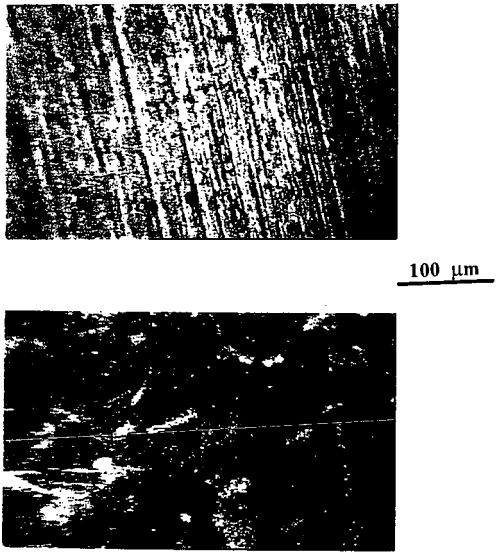


Figure 2. Micro FT-IR spectra and micrographs of solid deposits from Norpar-13 on different sides of a nickel foil: A: smooth side, B: rough side.

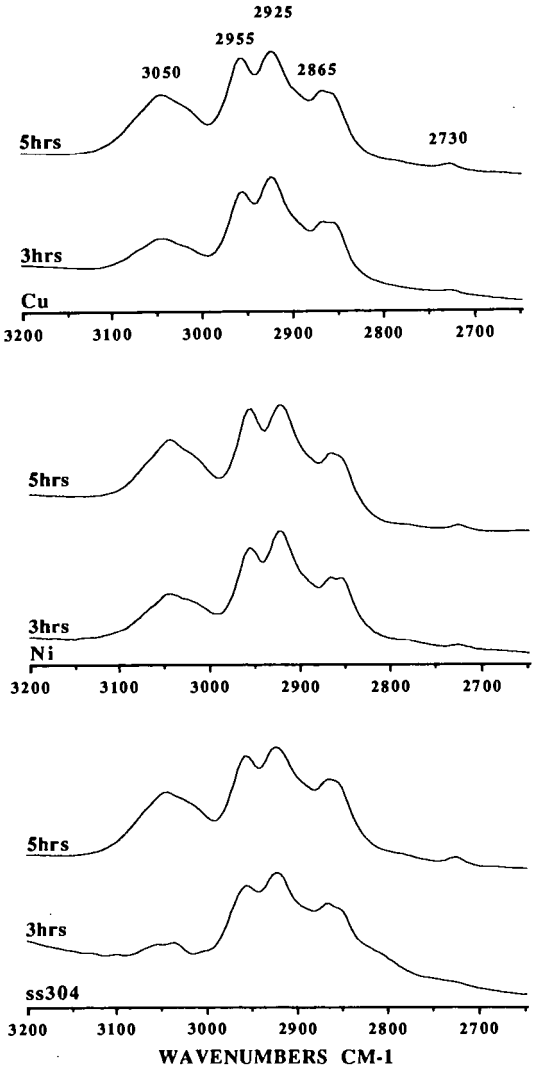


Figure 3. Micro FT-IR spectra of solid deposits from n-dodecane on different metal substrates as a function of time at 450°C.